PATENT APPLICATION

SOFT LIGHT FIXTURE

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TECHNICAL FIELD

The present invention is a soft light fixture. In particular, it is an LED soft light fixture.

BACKGROUND ART

Generally, various light fixtures that use light from a combination of light sources are known including U.S. Patent Nos. 4,280,171, 4,831,755, and 6,149,283.

Often, prior art devices that rely on the light from a combination of light sources show "hot spots." In particular, prior art light fixtures using light emitting diodes ("LEDs") use a large number of LEDs to generate the desired amount and color of light. However, typically, the points at which each individual LED are mounted are usually markedly visible as "hot spots" rather than the light of all the LEDs blending together to form a uniform glow.

Thus, a light fixture that uses a minimum of LEDs to generate a single light source without "hot spots" is desired. Moreover, a light fixture that blends light from different color LEDs into a single blended light source, e.g. of a new color, is desirable as well.

SUMMARY OF THE INVENTION

The present invention is a soft light fixture. In particular, it is an LED soft light fixture. The preferred embodiment of the soft light fixture has a plurality of light emitting diodes mounted on a printed circuit board ring and seated on a perimeter ring. The LEDs are aimed to emit light into a light mixing chamber. The perimeter ring supports a light deflection cap with a lens, preferably translucent. The perimeter ring, deflection cap and lens define the light mixing chamber which blends light from the plurality of light emitting diodes into a single light source. The lens preferably has a skirt that contains the printed circuit board ring, perimeter ring, and deflection cap.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention, which are believed to be novel, are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages, may best be understood by reference to the following description, taken in connection with the accompanying drawings.

Figure 1a is an exploded perspective view of a preferred embodiment of the present invention.

Figure 1b is an exploded perspective view of an alternative embodiment of the present invention.

Figure 2a is a side view of a preferred embodiment of the perimeter ring.

Figure 2b is a side cross-sectional view of a preferred embodiment of the perimeter ring.

Figure 2c is a top view of a preferred embodiment of the perimeter ring.

Figure 3a is a perspective view of a preferred embodiment of the deflection cap.

Figure 3b is a side cross-sectional view of a preferred embodiment of the deflection cap.

Figure 4a is a side view of an alternate embodiment of the lens.

Figure 4b is a side view of an alternate embodiment of the lens.

Figure 4c is a side view of an alternate embodiment of the lens.

Figure 4d is a side view of an alternate embodiment of the lens.

Figures 5a, 5b, and 5c are graphs of light intensity, beam diameter as a function of distance from the lens of the present invention.

Figure 6 is a preferred embodiment of an unmounted LED for use with the present invention.

Figure 7 is a preferred embodiment of a printed circuit board ring for use with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[1] The following description is provided to enable any person skilled in the art to make and use the invention and sets forth the best modes contemplated by the inventor of carrying out his invention. Various modifications, however, will remain readily apparent to those skilled in the art, since the general principles of the present invention have been defined herein specifically to provide a soft light fixture.

[2] Referring now to Figure 1a, an exploded perspective view of a preferred embodiment of a soft light fixture 10 is shown. The soft light fixture 10 preferably comprises a perimeter ring 20 having a plurality of notches 22 for lights. A preferred embodiment of the ring 20 is shown in Figures 2a, 2b and 2c. There are nine (9) notches 22 shown in Figure 2c. Returning to Figure 1a, a number of lights 25, preferably light emitting diodes (LEDs), are mounted on a printed circuit board (PCB) ring 60. The PCB ring 60 is preferably flexible and has two leads 65 for connection to a power source (not shown.) Each LED 25 in turn is seated in a corresponding notch 22 on the perimeter ring 20. Alternatively, each LED can be hard-wired to the fixture 10 instead of using a PCB ring.

[3] Preferably, each PCB ring 60 has a separate circuit for different sets of LEDs. For example, in Figure 7, the PCB ring 60 has three separate circuits 61, 62 and 63. As shown, each circuit controls three LEDs. This allows different sets of LEDs to be used together. For example, this allows a mix of different voltage LEDs. White, blue and green LEDs commonly need 3.5 volts and red, amber and yellow commonly need 2.5 volts. The separate circuits can also vary the LEDs' intensity and, thus, vary the color and intensity emitted by the light fixture 10.

[4] By using separate circuits on the PCB ring 60, the PCB ring can have a set of leads 65 for each circuit. Thus, each circuit and set of LEDs can be controlled separately, e.g. dimming or powered higher using a simple dimmer or more sophisticated DMX controller.

[5] The perimeter ring 20 supports a deflection ring 30. The perimeter ring 20 and deflection ring 30 are preferably made of white polycarbonate plastic. Referring to Figure 2c, the perimeter ring 20 has an interior diameter 25 that is less than the diameter of the perimeter ring 20. The progression from the diameter of the perimeter ring 20 to the interior diameter 25 shown in Figure 2b is a perimeter slope 29. Preferably, an angle (alpha prime, α') is formed between the perimeter slope 20 and the interior diameter 25. The angle α' is preferably forty-five degrees (45°).

[6] The perimeter ring 20 preferably has at least one post 27. Referring now to Figures 3a and 3b, a preferred embodiment of the deflection ring is shown. Figure 3b shows a cross-section of a preferred embodiment of the deflection ring 30. The deflection ring 30 preferably has at least one post port 33 that receives a post 27 on the perimeter ring 20. The deflection ring 30 mounted on the perimeter ring 20 defines a light-mixing chamber. The deflection ring 30 further comprises notches 32 that align with the notches 22 on the perimeter ring 20 to define light ports for seating lights 25, e.g. LEDs. Each light 25 is preferably aimed to cast light into the light mixing chamber.

[7] A lens 40 tops the deflection ring 30. As shown in Figures 1a, 4a and 4b, the lens 40 can have a skirt 45 extending down to contain the perimeter ring 20 and deflection ring 30. Preferably, the skirt 45 comprises tabs 47 arrange along an edge of the skirt 45. Alternately, the tabs 47 can be located on the perimeter ring 20. Regardless of their location, the tabs 47 are generally used to assist in assembling the fixture and/or waterproofing the fixture. Alternatively, one of the lenses 40, shown in Figures 4c and 4d, can be mounted on the deflection ring 30. The lens 40 can be flat as shown in Figure 4c or

concave/convex as shown in Figure 4d. Preferably, the lens 40 is made of translucent white polycarbonate or translucent white acrylic plastic.

[8] As shown in Figure 1a, a fastener ring 50 with fastener ports 55 can be used to hold the lens 40 together with the deflection ring 30 and perimeter ring 20 or mount the fixture 10 to a surface, e.g. a wall, chair, or floor. Figures 1b, 4a and 4b show an alternative embodiment of the lens 40 with a flange 49. The flange 49 can be used to mount the fixture 10 to other external fixture housings.

[9] Referring to Figures 3a and 3b, the deflection ring 30 has an interior diameter 35 that is less than the diameter of the perimeter ring 20. Preferably, the deflection ring's interior surface slopes to the interior diameter 35. This progression to the interior diameter 35 creates a deflection slope 39 that deflects light from the LEDs 25 into the light mixing chamber. Preferably, the deflection slope 39 extended forms an angle (alpha, α) at least 135 degrees from a top diameter 34 of the deflection ring 30.

[10] Conversely, the interior diameter 35 is less than a lower diameter 37. This progression from the lower diameter 37 to the interior diameter 35 shown in Figure 3b is notch slope 31. Preferably, the notch slope 31 extended forms an angle (beta, β) of 135° from the lower diameter 37 of the deflection ring 30. Thus, the LEDs 25 are generally obscured from direct view by the slope 39 of the deflection ring 30. Instead, the light from the LEDs is reflected into the light-mixing chamber defined by the above-described components to produce a soft light visible to a viewer without "hot spots."

[11] It should be noted that the present invention generates consistent lighting out to the outer edge of the fixture 10. The fixture 10, in general, does not have, what is commonly called a "trim ring," namely a dark ring along the edge of the lens 40. Thus, the fastener ring 50 is not used to hide a dark ring at the edge of the lens 40 but, instead, is used for mounting purposes and other reasons described above.

[12] Referring now to Figures 5a-5c, this invention 10 provides a soft light of an intensity useful in a number of applications. Figures 5a-5c show graphs of beam spread and intensity as functions of distance from the fixture 10. Referring to Figure 6, preferably, the LEDs are 20-40 milliamps (ma) light emitting diodes. If white light is desired, then only white LEDs are mounted in the notches 22 defined by the perimeter and deflection rings. Alternately, using a combination of colored LEDs mounted in the notches 22 can create soft lighting with a variety of colors. For example, if a "pink-ish" light is desired, six red LEDs and three white LEDs could be mounted on the PCB ring 60 in order to cast a pink-ish light from the device 10. Another alternative is to color the lens 40 the desired color or use a colored gel with the fixture 10.

[13] One preferred embodiment of the invention as described above uses three sets of three LEDs. Thus, combinations of LEDs are preferably based on multiples of three, e.g. three red LEDs and six white LEDs or six red LEDs and three white LEDs. The different circuits on the PCB ring 60 can also vary the color of light emitted by the fixture 10. For example, two sets of three LEDs could run at 20 milliamps while a third set runs at 40 milliamps. The resistors for each circuit could also be changed to vary the power, brightness and intensity of the LEDs as well.

[14] The present invention provides an improved color consistency over the prior art as well. Typically, when dies of LEDs are produced, the LEDs are sorted into bins by a number of criteria including a large range of "acceptable" colors, or wavelengths, intensity and forward voltage. The LEDs, depending on tolerance for color variation, can be sorted several more times to isolated colors within ranges of 1-3 nanometers in wavelength. However, isolating LEDs of a color with 1 nanometer of wavelength can be very expensive. The present invention allows LEDs of a wider variation in wavelength to be used and their light mixed to produce a single color light and thus hide slight variations in color between LEDs.

[15] Thus, a soft light fixture is described above that uses a minimum of LEDs to generate a single light source without "hot spots" is described. Moreover, a light fixture that blends light from different color LEDs into a single blended light source of a new color is described as well. In each of the above embodiments, the different positions and structures of the present invention are described separately in each of the embodiments. However, it is the full intention of the inventors of the present invention that the separate aspects of each embodiment described herein may be combined with the other embodiments described herein. Those skilled in the art will appreciate that adaptations and modifications of the just-described preferred embodiment can be configured without departing from the scope and spirit of the invention. Therefore, it is to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described herein.